

# High tibial osteotomy in degenerate diseases of the knee

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Accepted 21st January 1985.

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## SUMMARY

*Between 1970 and 1981, 64 patients underwent 77 tibial osteotomies for degenerate diseases of the knee at the Withers Orthopaedic Centre in Belfast. Records on 11 patients (12 knees) were either missing or inadequate, leaving 53 patients who underwent 65 tibial osteotomies for study. There were 23 males and 30 females, ranging in age from 23 to 75 years (mean 59.8 years). The predominant diagnosis was osteoarthritis and the indication for operation in all cases was pain. With a follow-up of from two to ten years (mean 4.8 years), 39 knees were assessed as good, 15 as fair (improved, but still symptomatic), and 11 as failures. Patients with valgus deformity did worse than those with varus deformity. The importance of adequate pre-operative assessment is stressed, the operation itself is outlined, and the end result is seen to correlate closely with the degree of correction obtained.*

## INTRODUCTION

High tibial osteotomy is an operation of proven value for relieving pain and improving function in the degenerate knee. Despite the increasing success and acceptability of total knee replacement,<sup>1, 2, 3</sup> there is often justifiable reluctance to consider arthroplasty, especially in the younger patient with unicompartmental disease. As most of the patients considered suitable for this procedure have a good range of movements, arthrodesis is not an acceptable alternative. The predominant indications for high tibial osteotomy are pain, accompanied by valgus or varus deformity, and a reasonable range of movements.<sup>4</sup> The causes of the pain are not fully understood. Lloyd-Roberts in 1953<sup>5</sup> cited capsular fibrosis as the cause, but Phillips et al<sup>6</sup> felt the major cause was venous congestion. More recent work suggests that articular cartilage breakdown

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products have a role. The pain is characteristically worse on standing or walking, as the deformity increases with weight-bearing. The fact that tibial osteotomy successfully relieves joint pain was reported by Jackson and Waugh in 1961,<sup>4</sup> and, subsequent reports<sup>7, 8, 9, 10, 11, 12</sup> have all indicated that the operation of tibial osteotomy is reliable in properly selected cases.

This paper outlines the experience of tibial osteotomy in Northern Ireland from 1970 to 1981. In Northern Ireland, prior to 1974, tibial osteotomy was the only alternative to arthrodesis in degenerate knee diseases. From 1974 onwards, this procedure was used more frequently for its more classical indications of the mobile varus or valgus knee with relative sparing of one compartment as an alternative to the Marmor unicompartmental replacement. All the osteotomies were performed above the insertion of the patellar tendon. Two types of osteotomy were employed, the wedge osteotomy (and a variation of this, the bracket osteotomy) described by Slocum et al,<sup>13</sup> and the dome osteotomy which we will describe. Patients were assessed pre- and post-operatively with regard to pain, range of knee movements, and mobility skills. Two to 10 years follow-up was available on all patients.

## MATERIALS AND METHODS

From 1970 to 1981, 64 patients underwent 77 tibial osteotomies for degenerate diseases of the knee. Due to absence or inadequacy of records in 11 cases (12 knees), 53 patients (65 tibial osteotomies) were available for study. The diagnosis in 60 knees was osteoarthritis, four of these being due to previous intra-articular fractures. There were five cases of rheumatoid arthritis. Fifty knees underwent bracket or wedge osteotomy, the osteotomy being held by staples (43 cases), plaster of Paris (9 cases), or Charnley clamps (3 cases). The technique of bracket and wedge osteotomy has previously been described.<sup>13</sup> Eleven knees (mostly occurring later in the series) had 'dome' osteotomy performed.

The patient is anaesthetised on a standard table, and a pneumatic tourniquet applied. The fibula is first obliquely osteotomised through a separate incision at the junction of its upper and middle thirds. The tibia is exposed through a curved or transverse incision at about the level of the tibial tubercle. The patellar tendon is isolated and raised clear of the anterior surface of the tibia, its attachment remaining undisturbed. The osteotomy is commenced using a series of one-eighth inch drill-holes parallel with the joint surface in the shape of a dome, the apex of which should ideally lie one centimetre below the joint line. A hand drill is used, preferably, because its superior 'feel' allows the posterior cortex to be perforated safely without undue risk to the vital structures at the back of the knee. The osteotomy is completed using an osteotome. Manipulation facilitates the displacement, which, in the case of a varus knee, should aim at 5° of over-correction (Fig. 1a and b). With a valgus knee, the correction should ideally be to neutral. The 'step' seen in the post-operative x-rays (Fig. 2) is a good indication of the degree of correction obtained. Post-operatively, the correction is held in plaster of Paris until union is achieved. No internal staples are employed, so that, if the correction is not adequate, a further manipulation is possible. Union occurred in almost all cases in our series within 10 weeks.

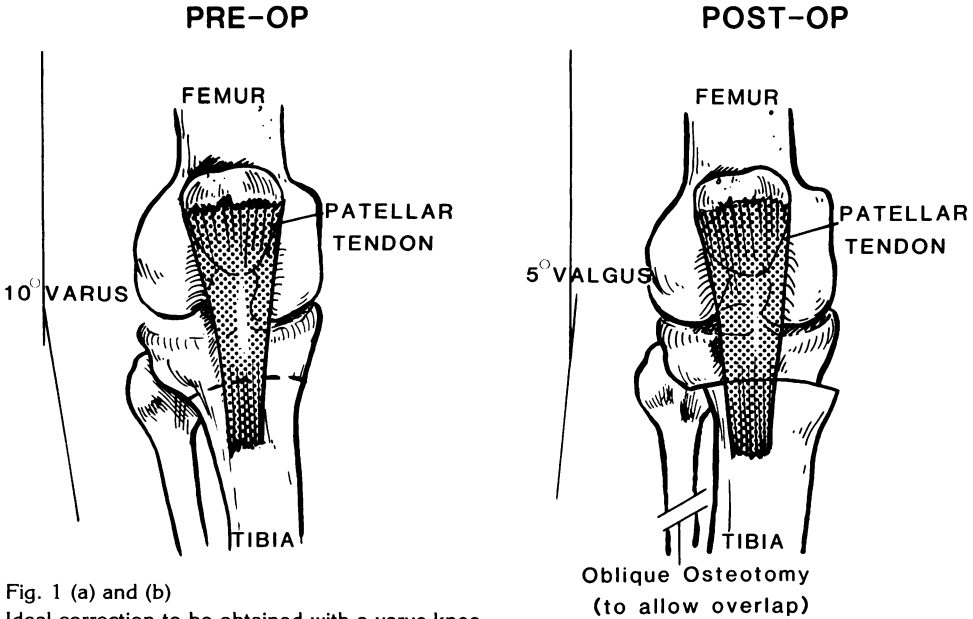


Fig. 1 (a) and (b)  
Ideal correction to be obtained with a varus knee.



Fig. 2  
Varus knee post-operative (in split plaster)  
showing the 'step' denoting good correction.

## RESULTS

The 53 patients in our series (65 osteotomies) were followed up for between two and 10 years (mean 4.8 years). They were assessed both pre- and post-operatively with regard to pain, range of knee movements, and walking ability. The degree of pain relief achieved by this operation was very marked. Pre-operatively, 97% of patients complained of moderate or severe pain. Post-operatively, 82% of patients had only mild pain, or none at all (Fig. 3).

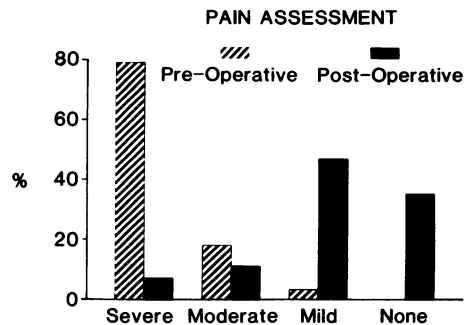


Fig. 3  
Pain assessment pre- and post-operatively.

Similarly, there was an improvement in the maximum flexion achieved by the patient from 41 % with flexion greater than  $100^{\circ}$  pre-operatively, to 61 % with this degree of flexion post-operatively (Fig. 4). It is undoubtedly true that much of the improvement in the range of movement was due to the considerable pain relief achieved by the operation.

The improvements in symptoms with regard to pain and limitation of movement brought with them increased mobility as expressed by walking ability (Fig. 5). This improvement in mobility is not as dramatic as occurs with total knee replacement,<sup>1, 14</sup> but then, it is not expected to be so, and, in any case, a high percentage of these patients were fairly mobile pre-operatively.

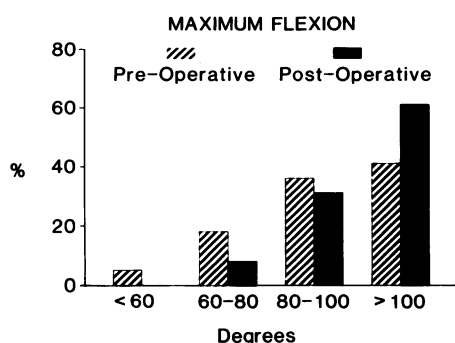


Fig. 4  
Range of flexion pre- and post-operatively.

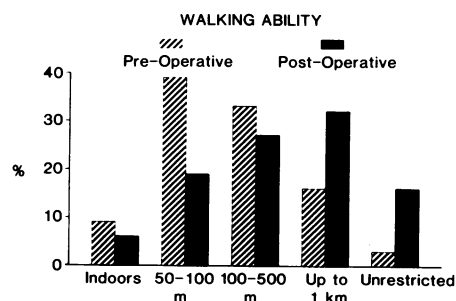


Fig. 5  
Walking ability pre- and post-operatively.

Taking the overall results, 60% of patients had a good functional result and were prepared to consider a similar procedure on the contralateral side. Fifteen knees (23%) had only a fair result, in that, although improved, there remained significant symptomatology. Eleven knees (17%) must be considered as failures (Table). There were three early outright failures, two of these being arthrodesed and the other being converted to a knee replacement. A further three cases were considered for knee replacement at between one and two years from the original operation and have now all undergone successful arthroplasty. Three had persistence of pain and in two of these cases there was the added complication of recurrent valgus. Another knee assessed as poor achieved considerable improvement with regard to pain at the expense of greatly diminished movements. Finally, one osteotomy was complicated by persistent non-union, despite three attempts at grafting.

TABLE  
*Results of tibial osteotomies*

	Good	Fair	Poor/Failure	Total
Valgus knees	6 (34%)	8 (44%)	4 (22%)	18
Varus knees	33 (68%)	7 (16%)	7 (16%)	47
Overall results	39 (60%)	15 (23%)	11 (17%)	65

Many knees were classed as fair on the basis of post-operative persistence of a moderate degree of pain. This was especially the case with valgus knees, where the deformity being corrected was often quite marked. Two knees finally rated as fair had delayed union, and one non-union (the latter requiring a bone graft). Three cases which were good results are now being assessed for total knee replacement at 6, 8 and 10 years respectively. Five patients remain symptom-free more than eight years after operation.

If the overall results are broken down according to whether the knee was initially valgus or varus, significant trends are noticed. With the valgus knees, only one-third achieved a good result. Forty-four per cent was only fair, and 22% were failures. This contrasts quite markedly with the results in varus knees. Here, 68% had a good result, with 16% in each of the fair and poor categories. The mean correction in the valgus knees was from 27° pre-operatively to 4.5° (valgus) post-operatively. Thus there was a tendency to correct only to physiological valgus and not to neutral. With varus knees the correction obtained was from 11.5° pre-operatively to 2.4° (valgus).

Complications were relatively few, apart from the three patients who required early conversion to either arthrodesis or knee replacement. The most serious complication was that of a patient with persistent non-union (despite three bone grafts). This patient has now achieved a fibrous union and is mobile on a stick. She has declined any further surgery. There were two cases of delayed union and one of non-union (the latter requiring a bone graft). In four cases wound problems delayed discharge from hospital, but the wounds eventually healed. There were no cases of common peroneal nerve injury or compartment syndrome.

## DISCUSSION

Many authors report benefits achieved by tibial osteotomy in properly selected cases.<sup>4, 7, 8, 9, 10, 15, 16, 17, 18</sup> In our series, we were impressed by the overall improvement achieved, particularly with regard to pain relief. The improvement in range of movement and overall mobility was also quite marked. The operation of tibial osteotomy is, however, often compared in the patients' mind with that of knee arthroplasty. Any residual incapacity may then only be accepted with reluctance. It is important to explain the nature and expected outcome of the operation to the patients so that they do not entertain unrealistic expectations.

The precise estimation of the pre-operative deformity is mandatory,<sup>11, 12, 19</sup> since good results are closely correlated with accurate correction. Pre-operative arthroscopic assessment is probably unnecessary.<sup>20</sup> Coventry<sup>21</sup> considers bone-scanning to be most valuable in assessing the likely outcome and has shown that if both compartments are affected as demonstrated by increased uptake, then the result is likely to be disappointing. Several authors stress the importance of standing x-rays in evaluating the true deformity,<sup>19, 22, 23</sup> and a case from our own series re-emphasises this, where the supine deformity of 3° of varus increased to 7° on standing. With regard to pre-operative assessment, those patients whose deformity was marked generally did badly. Insall<sup>19</sup> maintains that with varus deformity exceeding 10° or valgus deformity greater than 15° tibial osteotomy is contra-indicated. It is certainly true that patients with marked valgus deformity generally do badly. In our series, all those with valgus deformity exceeded 15° on standing x-rays, and this probably contributed to the high incidence of indifferent and poor results in these cases. Agletti<sup>23</sup> and Coventry<sup>21</sup> both stress the

importance of over-correcting a varus to between  $5^{\circ}$  and  $10^{\circ}$  of valgus. In our series, this over-correction was apparent (mean correction obtained from  $11.5^{\circ}$  (varus) pre-operatively to  $2.4^{\circ}$  (valgus) post-operatively), and, this may, in part, explain the high percentage of good results (68%). Four of the seven bad results were not corrected to beyond neutral and consequently suffered recurrent varus. Our best result from an initially varus knee (symptom-free at 10 years) was over-corrected at operation to  $10^{\circ}$  of valgus.

The much poorer results with initially valgus knees merits close scrutiny. Shoji and Insall<sup>24</sup> maintain that with valgus knees correction to  $5^{\circ}$  valgus is indicated and that such deformity should not be corrected to neutral. Coventry<sup>21</sup> feels that some degree of over-correction may be necessary to prevent recurrent valgus. In our series, the mean correction with valgus knees was from  $27^{\circ}$  to  $4.5^{\circ}$ . There was therefore a tendency to correct only to physiological valgus and not to neutral, and a tendency to recurrent valgus was evident. Attempts to correct too great a deformity are likely to give a bad end result. Thus, those with valgus deformities of greater than  $20^{\circ}$ , or varus deformities exceeding  $15^{\circ}$  generally had indifferent or poor outcomes. Where the initial deformity lay between  $15^{\circ}$  of varus and  $20^{\circ}$  of valgus (on standing x-rays) the outcome was generally good. Marked pre-operative restriction of movements was noted to correlate with worse results, an observation noted by other workers.<sup>4, 21, 23</sup>

## CONCLUSIONS

Despite the increasing success of total knee replacement in the treatment of degenerate diseases of the knee, there remain definite indications for tibial osteotomy. These are:

- (a) Relatively young patients, with
- (b) Painful, mobile knees, and
- (c) Valgus or varus deformity in the range  $20^{\circ}$  valgus to  $15^{\circ}$  varus (weight-bearing) with relative sparing of one compartment.

Applying these indications, tibial osteotomy can offer long-term relief to many. It will often defer by years the time when arthroplasty becomes necessary, and in a good percentage of cases no further surgical treatment will be indicated.

We wish to thank our colleagues in the Withers Orthopaedic Centre for their help and co-operation in this survey, Mr Brendan Ellis and Mr Ronnie Wood for their illustrations and photography and Miss Lily McGuffin for the typing of the manuscript.

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